

**Graduate Training &
Career Development**

2010

Graduate Training & Development

Contents

	Page
Introduction	1
Overview of training provided for Students	2-4
Transferable Skills Training and Credit Allocation	5-6
Induction Programme	7-10
Outline of Induction Programme Presentations	11-15
Home Office – Project and Personal Licence Training	16-18
Presentation Skills	19
Poster Presentation Workshop	20
Media Training	21
Statistics	22
Project Management	23
Technical Writing	24
Team Development Workshop	25
From PhD to Professional	26
Leadership Skills	27
Time Management	28
Equality and Diversity Awareness	29
Harassment Awareness – Building Positive Relationships	30
How to write a CV and perform well at Interviews	31
Intellectual Property & Knowledge Transfer	32
Writing a Research Fellowship Application	33
Computer Skills Courses	34-36
Graduate School of Life Sciences: Introduction to Training Programme	37-49
Vitae programme	50-56
Useful Definitions and Principles – Correct and Effective Concentrations	57-64

Graduate Training and Development

The Babraham Institute believes that the training and development it provides for its students not only contributes towards the success of the individuals but also enhances the reputation and standing of the Institute. It is, therefore, committed to ensuring that every student who comes to Babraham receives the training and development which will not only lead to the successful completion of a PhD but which will also set the foundation for good scientific and management practice in the future.

The Institute is a recognised Partner Institution of the University of Cambridge. All students are registered with the School of Biological Sciences and our staff are full University supervisors. The Institute works with the University, the BBSRC and various external training providers to ensure that each student receives a broad range of training through a variety of facilities. In addition, there are a number of individuals and services on site that provide training and guidance in the form of workshops, one to one coaching, help-lines, etc.

All students take part in a compulsory programme of Induction and continual development. There are also a number of optional courses available for those students who are interested in pursuing certain topics, e.g. working with the media. Each student is assessed individually in some areas, e.g. computing skills, to ensure that training is carried out at the correct level for them and that any special scientific training relating to their specific project is also covered.

The Graduate Training and Development Brochure, which is given to students when they arrive at Babraham, outlines the Induction Programme and describes the courses available to them throughout their time at Babraham. It also describes the courses available through the Graduate School of Life Sciences and the Vitae Programme. The Vitae Programme runs a series of three to four day national residential workshops designed specifically for doctoral students. The Programme's provide participants with an excellent opportunity to raise their awareness of their personal competencies relative to their research studies, their personal development, and their continuing professional development. See testimonial to this on page 49 of this brochure.

Within the Institute there are a number of individuals who are responsible for ensuring that every student receives the appropriate training and development. These include: the Supervisor, Assessor and Mentor allocated to each student; the Graduate Studies Tutor; Members of the Graduate Committee; the Personnel Officer. Although there are a number of people available to provide advice and assistance, students are also expected to take responsibility for their own continuing development. They are, therefore, encouraged to attend lab. talks, lectures, seminars, presentations, etc., to network and broaden their scientific knowledge. Students should discuss any training needs initially with their Supervisor but may seek advice from any of the above.

Transferable Skills Training

Under the terms of the Roberts funding for Transferable Skills Training (TST), graduate students are expected to undertake an average of 10 days of TST activities per year of their studentship.

Following the “credits” system currently being used by the University of Cambridge Graduate Education Committee, The Babraham Institute has agreed that all PhD students must achieve 60 credits over the duration of their PhD. Credits are obtained by: the attendance of formal compulsory courses; on the job training; attendance and contribution to seminars and conferences; presentation of posters; participation in Laboratory/Institute activities involving TST; taking action to develop existing transferable skills, i.e. through writing progress reports, etc.

In addition, there are number of optional courses which students can attend both at the Institute and externally which will be specific to their needs and which can be counted towards their total number of credits. One credit is awarded for ½ a day’s activity.

However, credits are not allocated to courses which are concerned purely with subject specific research techniques. In addition, only a maximum number of credits may be gained for the same activity. For example carrying out laboratory demonstrations for undergraduates is a valid training experience in teaching undergraduates. However, there is a limit to when this “training experience” ceases to be training and becomes experience, for the PhD student. Therefore, only 4 credits, i.e. 4 half days of demonstrations/teaching may be counted towards a PhD student’s total.

For the level of credits to be achieved, it is essential that most activities are compulsory. However, the Institute has already designated many of the formal courses it organizes as compulsory as it has believed in the importance of transferable skills training for many years.

An explanation of TST activity and a record of credits achieved must be maintained by all students in their Student Log Book and discussed with their supervisor at review meetings.

Example Induction Programme – October 2009

Aims

- To introduce new students to each other and to key people at the Institute.
- To inform students about the mission, aims, objectives and work of the Institute.
- To ensure that students receive the information they require to settle into the Institute and laboratory as quickly and efficiently as possible.
- To create a forum where students can have their questions about the Institute answered.
- To ensure that students receive the guidance and training on Health and Safety within their first week on site.
- To assess each students computer skills to ensure that every Individual receives the correct level of training.

Thursday, 1st October

Hardwick Room

9:30	Welcome to the Institute	Dr Peter Evans	Graduate Studies Tutor
9:45	The Graduate Programme	Dr Peter Evans	Graduate Studies Tutor
10:15	Personnel and Training & Development	Mrs Jill Skinner Ms Caroline Coursol	Head of Personnel Personnel Officer
10:40	Security	Mr Richard Stocks	Security Manager
11:00	Coffee		
11:15	Ethics in Scientific Research	Dr Caroline Edmonds	Deputy Director (Operations) and Company Secretary
11:45	Introduction to Management Structure of Institute	Dr Caroline Edmonds	
12:00	Photographs for ID cards		Security Control Room – Building 402
12:30	Lunch with Graduate Committee and Supervisors		Hardwick Room

Group A

2:00	Computing Induction	Ms Lou Carter	IT Training Room
3:30	General Paperwork	Ms Caroline Coursol	Boardroom

Group B

2:00	General Paperwork	Ms Caroline Coursol	Boardroom
3:30	Computing Induction	Ms Lou Carter	IT Training Room

Friday, 2nd October

Group A

10:00	Harassment Awareness Seminar	ACAS	Hardwick Room
1:00	Lunch Break		
1:30	Safe Manual Handling of Objects, Use of Display Screen Equipment and Repetitive Strain Injury	Mrs Jane Goode	Conference Centre

Group B

10:00	Safe Manual Handling of Objects, Use of Display Screen Equipment and Repetitive Strain Injury	Mrs Jane Goode	Conference Centre
1:00	Lunch Break		
1:30	Harassment Awareness Seminar	ACAS	Hardwick Room

Monday, 5th October

Hardwick Room

9:30	Animal Welfare & Home Office	Dr Colin Gilbert	Head of Veterinary Services
10:00	Small Animal Facility	Mr Ian Horseman	Deputy Manager
10:30	Technical Transfer	Mr Derek Jones	Chief Executive Officer (BBT)
11:00	Coffee		
11:15	Institute's Imaging Facility <i>(talk in the Hardwick Room about the use of imaging followed by a tour of the Facility)</i>	Dr Simon Walker	Imaging Facility Manager
12:00	Bioinformatics/Molecular Biology <i>(talk in the Bioinformatics Department located in the Forum building)</i>	Mr John Coadwell / Dr Simon Andrews	Head of Bioinformatics Bioinformaticist
12:30	Lunch Break		
1:15	Q & A with current students		Forum Seminar Room
2:15	Fire Extinguisher Training	Mr Richard Stocks Mr Ted Smith	Hardwick Room

Tuesday, 6th October**Hardwick Room**

9:30 Equality and Diversity Awareness Miss Chris Rushforth Training & Development Officer

11:30 Coffee

11:45 Introduction to the Library Miss Jennifer Maddock Librarian

12:30 Lunch Break

Conference Centre

1:30 Health & Safety Mr Trevor Cooper Health & Safety Manager

2:30 Laboratory Safety Mrs Kathy Hadfield-Moorhouse
Mr Neil Brew
Dr Trevor Smith

Meet outside Conference Centre**Group A**

4:00 Technical Services Tour Mr Chris Chapman Technical Services Coordinator

4:30 BBT – Campus Tour Mrs Nicola Kinsey Sr Operations Manager (BBT)
Mr Gavin Dearsley Bioincubator & Facilities Manager

Group B

4:00 BBT – Campus Tour Mrs Nicola Kinsey Sr Operations Manager (BBT)
Mr Gavin Dearsley Bioincubator & Facilities Manager

4:30 Technical Services Tour Mr Chris Chapman Technical Services Coordinator

Wednesday, 7th October**Hardwick Room**

9:30 My Life and Times in Science
An Inspirational Talk by Professor Sir Michael Berridge

10:45 Good Laboratory Practice Dr Anne Corcoran Project Leader

11:15 Science and Society/
Communication Dr Claire Cockcroft Head of External Relations

11:45 Lunch Break

Conference Centre

1:00 Managing Your Project, Managing Your Time Hutchinson Training & Dev Ltd

Thursday, 8th October

IT Training Room

9:30 Intro/Intermediate Excel

Harrington Morgan

12:30 Lunch Break

1:30 Advanced Excel

Harrington Morgan

Friday, 9th October

CAMBRIDGE UNIVERSITY INDUCTION DAY

Monday, 12th October

IT Training Room

9:30 Photoshop Elements Introduction

Harrington Morgan

12:30 Lunch Break

1:30 Photoshop Elements Intermediate

Harrington Morgan

Friday, 16th October

7:00 Student Welcome Party

Conference Centre

Upcoming Training:

Friday, 20th November

9:30 – 5:00 Team Development Workshop

Conference Centre

Induction Programme

Introduction to Student Life at Babraham

Topics covered by the Presentation

- Aim of the Student Programme
 - Student Committee
 - Student Life at Babraham
 - Formal Assessment
 - University of Cambridge
 - Training Opportunities
 - Supervisory Practice
 - Staff/Student Committee
 - Induction Programme
 - Student Party
- The role of the Supervisor, Mentor and Assessor
Links with the University of Cambridge
What Babraham provides
From Week 1 to End of Year 3.
The Graduate School of Life Sciences

The Babraham Organisation and Corporate Affairs

Topics covered by the Presentation

- The Structure of the Institute
 - The Babraham Intranet
 - Public Understanding of Science
- Organigram
Board of Directors
Scientific Advisory Panel
Finance & General Purposes Committee
Babraham Executive Committee
Associate Directors
Heads of Services
Scientific Laboratories
Bioincubator
- Annual Schools Day
School Liaison

Health & Safety

Topics covered by the Presentation

- Animals
 - Behaviour/Responsibilities
 - Biohazards
 - Bombs/Suspicious Packages/Security
 - Centrifuges & other major Equipment
 - Chemicals - COSHH
 - Cryogenics
 - Display Screen Equipment
 - Fire Safety
- The respiratory sensitization risk of exposure to small animals. (Followed up by a questionnaire during the first month).
- The legal duties of employees under HSW Act.
The dangers and procedures when working with biohazardous materials. (More job specific training is provided as and when required.)
- Basic postal and site security matters.
- The importance of following site rules for the use of expensive equipment.
- Outline of Regulations. (More job specific training is provided as and when required.)
- Potential dangers with examples. (More job specific training provided as and when required.)
- Regulations, eye test, workstation assessment.
How to use assessment on the intranet.
- Site system. (Building specific arrangements to be covered by Health & Safety Assistants on first day and Fire Fighting training at a later date.)

- First Aid/Accident Reporting How to get first aid assistance and report any accidents or incidents. (Health & Safety Assts. to introduce local first aiders on first day.)
- Genetically Modified Organisms Requirement to assess work. How to carry out an assessment.
- Hazards – General/Site Pedestrian/traffic areas, construction work, etc.
- Housekeeping Importance of clean and tidy laboratories, random inspections.
- Ionising (radioactivity)/Non-ionising (Laser/UV) radiations Registration with the Institute Radiation Protection Supervisor prior to starting work. (Training is given at the time of registration and is based on previous experience. Further on the job training is also given if required.)
- Manual Handling The importance of correct lifting. (Courses are run approximately every six months.)
- Personal Protective Equipment (PPE) Legal duty to wear any specified PPE mentioned in COSHH assessments or Institutes COP's.
- Pressure Systems – Positive (gases) Negative (vacuum systems) (More specific training provided as and when required.) The need for care - covering cylinder regulators, movement of heavy cylinders and freeze drying vessels.
- Sharps – Glass/Needles/Blades Covering cutting techniques, tidiness & disposal.
- Waste Disposal Importance of following correct procedures. (On the job training as and when required with Institute COP.)

Babraham Bioscience Technologies and Knowledge Transfer on the Campus

Topics covered by the Presentation

- The link between the Institute as an Educational Charity and its Commercial Activities
- Babraham Bioscience Technologies (BBT)
 - Campus development
 - Supporting bioventures and innovation
 - Promoting enterprise
 - Managing Technology arising from the Institute
 - Definition of a patent – Key features of a patent.
 - What is patentable.
 - What do patents do/don't do.
 - Who is entitled to a patent.
 - Administration/what to do/Record of Inventors.
 - Costs (provisional filing, PCT filing, National Phase, renewal fee)
 - Timing of each patenting stage
 - Making money from Patents
 - Patent licensing
 - Patent sale
 - Commercial venture
 - Rewards to Inventors
 - BBT's Technology Development Lab
 - Mission
 - Facilities, services and expertise available
 - What is a "Proof of concept" experiment, why is it needed
 - Developing ideas into commercial opportunities
- Why is Knowledge Transfer important!

Good Laboratory Practice

Topics covered by the Presentation

- Good Laboratory Practice
 - Planning
 - Reduces Stress
 - Increases Enjoyment
- A Scientist's Skills
 - A good background knowledge.
 - The ability to shape hypotheses or theories and to conceptualize models.
 - The ability to design properly controlled experiments.
 - An understanding of data gathering/recording.
 - The ability to see all of the data.
- Experimental Design
 - Aim of experiment
 - Identifying the variables.
 - Controlled experiments
 - Negative controls
 - Positive controls
 - "Walk through"
- Experimental Planning
 - Hypothesis-driven experiments.
 - Health & Safety Issues
 - When to modify techniques.
 - Checking of techniques
 - Working within budget
 - Techniques
 - Availability of equipment
 - Timescale
 - Prepare reagents in advance.
 - Discuss with senior colleagues.
 - Record all data.
- Other Factors
 - Trouble shooting (analytical skills)
 - Statistics (replicating experiments)
 - The human factor - resistance to new ideas/adherence to disproved ideas/dangers of generalization
 - The value of discussion
 - Scientific integrity (retain all primary data)
- Scientific Equipment
 - Read manual
 - Understand dangers and safety features
 - Seek demonstration
 - Test with proven samples/discover capabilities
 - Learn user-level troubleshooting
 - Carry out "pre-flight" checks
 - Report breakdowns
 - Book
 - Accidents do happen
- The Laboratory Notebook
 - Functions
 - Format
 - Index
 - What to record
 - Storage and security
- Managing Time -- Short Term
 - Read literature
 - Maintain bibliography

Long Term

- Design & carry out experiments
- Analyse results
- Attend Seminars
- Two month report
- First Year Report (8 months)
- Poster Presentation (Annual Lab Talks)
- Departmental Seminar (3rd year)
- Conference
- Research in collaboration laboratory
- Holidays
- Writing and Submitting Thesis
(2 – 3 Years)

Animal Welfare & Home Office Regulations

Topics covered by the Presentation

- Introduction to the licence system and the law
- Need for training and experimental planning
- Schedule 1 killing
- Implications of personal legal responsibilities
- Basics of ethics and cost/benefit analysis
- Key personnel and their roles
- Location of animal facilities
- Need for maintenance of animal health. Barrier facilities
- Access to prescription drugs

Small Animal Facility (SAF)

Topics covered by the Presentation

- Introduction to the Small Animal Barrier Unit (SABU)
- Introduction to the Small Animal Unit (SAU)
- The Role of the Support Technicians
- Facility Access
- Provision for New Facilities

Introduction to the Babraham Library

Topics covered by the Presentation

- Welcome and introduction to Library staff
- Format of initial training session
- Library opening hours
- The Library – physical layout
- Library Web pages
- Collections – journals, books, abstracts
- Photocopiers, including copyright
- Databases
- EndNote
- Inter-Library loans
- Membership of Cambridge University Library
- When you come to write your thesis
- Tour of the Library

Bioinformatics/Molecular Biology

Areas covered by the Presentation

- What is Bioinformatics
- What is the role of Bioinformatics at Babraham
- How does Bioinformatics support science
- The importance of the WWW and local computing
- Biocomputing Support Facilities
- Prediction of protein structure from sequence
- Secondary and tertiary structures of proteins
- Sequence identification and Oligo Design
- Genomic and cDNA Sequence Databases
- Structure Function Relationships
- Enzyme and metabolic pathway databases
- The Strategy for the future

Tour of the Site

Areas covered by the Tour

- | | |
|----------------------------|--|
| • Signalling | Confocal Microscope, Calcium Imaging, Single Cell Injections |
| • Molecular Immunology | BioRad instant Imager, FACS machine |
| • Monoclonal Antibody Unit | |
| • Animal Facilities | Small Animal Unit |
| • Microchemical Facility | |
| • Proteomics | Facilities |
| • Photography | Facilities |
| | Presentation opportunities |
| • Development | Transgenics |
| | Knockouts |
| • Babraham Campus | Tour of the physical site |

Basic Computing & Email

Areas covered by the Training Session

- Assessment of knowledge
- Code of Conduct
- Email accounts
- Introduction of computing staff and their roles
- Babraham computing support structure
- Available software on Site
- Other systems available on request
- Outlook - Basic Induction

Home Office Training for:

Obtaining a Personal Licence

Obtaining a Project Licence

Using a Schedule 1 technique to kill rodents

Responsibilities under the Animals (Scientific Procedures) Act

The Animals (Scientific Procedures) Act 1986 imposes clear responsibilities on persons with specific roles in relation to the care and use of animals in laboratories. These are elaborated further in the Guidance on the operation of the Animals (Scientific Procedures) Act 1986; this can be found on the relevant HO page, link on Intranet: Science Services/Animals.

The EC Directive for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes (86/609/EEC) specifies that those carrying out experiments shall have appropriate education & training.

As the roles differ, it follows that the education and training required before assuming these responsibilities will differ:

- **Personal licence** holders are responsible for the welfare of animals on which they carry out regulated procedures; applicants will be granted licences only if adequately trained to take on this responsibility, usually under supervision. External, accredited training providers are used.

Training will involve Modules 1 – 3, (2 -3 in the relevant species), will be required and if major surgical procedures under terminal or recovery anaesthesia is planned then Mod 4 will also be required.

- **Project licences** will be issued only to persons properly able to direct a programme of work that is well-justified and takes account of all reasonable possibilities for reduction, refinement and replacement. External, accredited training providers are used.

Training will involve Module 1 – 2 and Module 5 and also Modules 3 and 4 when appropriate to the procedures to be carried out in the project.

- **Schedule 1** requires practical training in the relevant technique and assessment for competence for the technique before rodents can be used; this on site training is undertaken by the named vet for site (NVS), or a limited number of listed, experienced Small Animal Facility staff. **Even experienced members of staff joining the Campus will require assessment.**

Training will involve Module 1 – 2 as well as the on-site practical training and assessment.

(Very limited exemptions from these requirements may be considered by the Home Office.)

On site Module 1 – 4 courses are held once a year in October; all other training takes place in Cambridge using University of Cambridge Biomedical Support Services, or in London using Bioscientific Events Ltd.

Please contact Jane Goode (6531) to organize all training and arrange for payment, also to answer any queries.

Note: no training involving using animals can take place, or even booked, until staff have undertaken their first session with the OHS nurse and had a Mask Fit Test. Contact Joan Horseman (6268) for the former and Jane Goode (6531) to arrange the latter.

No staff should enter any animal procedure room until this has occurred; they will also be refused access to all Small Animal Facilities.

Training modules

Information about training modules 1 to 5

Module 1

- Historical background:
Legislation and attitudes to animals and animal welfare in the United Kingdom
- An introduction to ethical aspects of the use of animals in scientific procedures
- The Animals (Scientific Procedures) Act 1986:
 - The Certificate of Designation
 - The Project Licence
 - The Personal Licence
 - Schedule 1
 - Schedule 2
 - Home Office Guidance on the Operation of the Animals (Scientific Procedures) Act 1986
 - Home Office Code of Practice for the Housing and Care of
 - Animals used in Scientific Procedures
 - Other codes of Practice and Guidelines
- Other relevant legislation

Module 2

- Recognition of wellbeing, pain, suffering or distress in the relevant species
- Handling and restraint of the relevant species
- Humane methods of killing appropriate to the relevant species
- Local procedures:
 - Security
 - Administration
 - Supply of animals
 - Disposal of animals
- Personal Health and Safety

Module 3

- Biology and husbandry of the relevant species
- Common diseases and recognition in the relevant species
- Health monitoring and disease prevention or control:
 - General principles
 - Principles of gnotobiology
 - Local practices and procedures
- Introduction to anaesthesia and analgesia in the relevant species
- Conduct of minor procedures in the relevant species:
 - Common methods of dosing
 - Common methods of sampling
 - Minor procedures not requiring sedation, analgesia or general anaesthesia
 - Other minor procedures involving sedation, analgesia or brief general anaesthesia

Module 4

- Surgical anaesthesia and analgesia in the relevant species
- Conduct of surgical procedures:
 - Principles of surgery
 - Common surgical procedures
 - Post-surgical care and monitoring

Module 5

- Ethical aspects of the use of live animals
- Analysis of the literature:
 - Critical appraisal
 - Literature searches
- Alternatives:
 - Refinement
 - Reduction
 - Replacement
- Project design:
 - Plan of work
 - Good laboratory practice
 - Appropriate laboratory methods
 - Selection of appropriate animal models
 - Appropriate statistical methods
- Project licence management:
 - Responsibilities
 - Supervision of personnel and programme of work
 - Record keeping requirements
 - Annual return of procedures
- Legal aspects - European, and wider international context

Timing of Training

First Year

Approximate Length of Programme

2-3 days

Compulsory/Optional

Compulsory for those working with animals

Presentation Skills

Aims

- To illustrate the importance of preparation
- To give delegates the skills to be able to design a well-structured presentation which will meet the required objectives.
- To show how to design appropriate and effective visual aids.
- To enable delegates to optimise their visual and vocal impact and to deal effectively with questions.
- To give delegates an opportunity to practise presentations and receive feedback using videotaped recordings.
- To give delegates increased confidence in making presentations.

Typical Programme

Day 1

Welcome and Introductions

Aims and Objectives of the course

The importance of preparation

Practical session – 1st Presentation

Practical session continued

How to deliver presentations

Day 2

The design of effective Visual Aids

Practical session – 2nd Presentation

Summary and Feedback

Timing of Training

First Year

Approximate Length of Programme

1 ½ days

Compulsory/Optional

Compulsory

Poster Presentation Workshop

Aims

The course aims to illustrate the basic issues to consider when designing a poster presentation. The course is interactive and delegates are encouraged to voice their opinions.

Typical Programme

Overview on how to prepare a poster in Powerpoint

- Use of a generic Poster template
- Insertion of text blocks and figures
- Consideration of colour schemes
- Layout, style and fonts

Designing your poster to suit your audience

- Specialist v general conferences
- Impact – how to get noticed
- How to explain your poster

Critique of posters - assessing

- Scientific content
- Clarity of message
- Suitability for audience

Timing of Training

First Year

Approximate Length of Programme

½ day

Compulsory/Optional

Compulsory

Media Training
Communicating with the Public

Aims

- To provide help and advice to BBSRC grant-holders on communicating with the public
- To provide an opportunity to share ideas and experiences of communicating science
- To give practise and guidance on writing a news article
- To enable participants to experience a media interview

Typical Programme

Welcome and Introductions

Science and the Public

Who are they and what are they interested in and concerned about? Why does it matter?

Why work with the media?

How the media work and what they want

Workshop – Writing to tempt journalists

Workshop – Speaking on TV & radio

Putting on a show

Logistics of presenting science at exhibitions, meetings, open days, etc.

Handling sensitive and controversial issues

Working with Schools

School Liaison

Resources available from the BBSRC

Timing of Training

When appropriate

Approximate Length of Programme

½ day

Compulsory/Optional

Optional

Statistics

Early in your first year (January/February) you will be given a one-day course in basic statistics and the software programme used at the Institute. The idea of this course is to “refresh your memory” on topics that you have probably been through before but may not be sure about anymore.

Course summary

The course contains 2 parts: experimental design, including power analysis, and basic statistics. This second part, which is mainly about descriptive stats and most used parametric tests, should allow you to get started with your analysis. The course lasts one day and leaves plenty of time for questions. If you let me know in advance, you can also bring your own data and we can go through it at the end of the course.

The course is hands-on session and uses SPSS as a statistical package. SPSS is officially supported for use at Babraham. It is a powerful and friendly package which would allow you to plot and analyze your data.

SPSS is available for both PCs and Macs but the course is only taught on the PC version of the software. It should still be useful to those using Macs.

Course content

- Experimental design
- Power analysis
- Sample size
- Presentation of SPSS
- Importing data from other software packages
- Preparing your data for analysis
- Getting to know your data and graphical representations
- Choosing and carrying out an appropriate analysis
- Interpreting analysis output

<u>Timing of Training</u>	First Year (January/February)
<u>Approximate Length of Programme</u>	1 day
<u>Compulsory/Optional</u>	Compulsory

Project Management

This course is run in-house by an external provider based on the Grad Programme's course and is geared towards guiding PhD students to effectively manage research projects.

Aims

- To understand the essentials of effective research project management
- To appreciate the relevance of effective communication to research project management
- To understand the importance of using effective formal project management techniques and how to apply them.
- To explore the importance of developing effective working relationships and managing conflict

Typical Programme

Project Management Essentials	<ul style="list-style-type: none">- understanding the basics of project management- how to apply project management techniques- understanding project management jargon- relevance of effective communication to project management
Objective Setting	<ul style="list-style-type: none">- the concept of SMART objectives- the importance of setting SMART objectives- the difference between aims and objectives
Effective Working Relationships	<ul style="list-style-type: none">- the importance of developing relationships with colleagues- how to manage working relationships
Conflict Management	<ul style="list-style-type: none">- how conflict can occur and spotting the signs- resolving the conflict- constructive conflict
Managing Meetings and Presentations	<ul style="list-style-type: none">- how to structure meetings and presentations effectively- how to convey your message and know your audience
Course overview	

Timing of Training Third Year

Approximate Length of Programme 1 day

Compulsory/Optional Optional

Technical Writing

Aims

- To illustrate the many common inaccuracies in scientists' writing and know how to avoid them.
- To help delegates become aware of the importance of writing clear, concise English and to understand various ways of achieving this.
- To show delegates how to plan and write the different components of a research paper.
- To enable delegates to be able to prepare clear, informative tables and figures.
- To enable delegates to edit the typescript of a research paper critically, to maximise the likelihood of its immediate acceptance by the target journal.
- To teach delegates to correct a proof accurately using the British Standards Institute marks.

Typical Programme

Welcome and Introductions

The importance of accuracy: choosing and using words; avoiding grammatical pitfalls

Brevity – making every word count

Clarity – avoiding ambiguity

Style – making your writing readable

Getting started – writing the outline, organising the data, designing tables and figures

Writing the text – materials and methods, results, introduction, discussion, abstract, references, title, acknowledgements

Editing the text

Correcting the proofs

Timing of Training

First Year

Approximate Length of Programme

1 day

Compulsory/Optional

Compulsory

From PhD to Professional

Aims

- Define the role of a manager in a scientific environment.
- Identify the personal change this will need.
- Communicate effectively with their staff.
- Understand the basis of motivating self and others.
- Delegate confidently.
- Set tasks and standards.
- Use time and people resources efficiently.
- Exercise team leadership

The rationale in course design is to introduce students to Myers Briggs Personality Typing and then use the language that this will provide us with, to broaden discussion into aspects of professionalism and motivation. There will also be some focus on careers, CV's and applications, with an element of self analysis (SWOT) and some onward action planning.

Typical Programme

Introduction

Introduction to Type (MBTI)

MBTI Questionnaire

How do I communicate?

Know your organisation.

(Strategies for working effectively using organisational type as a basis)

Professionalism and Assertiveness

What motivates me and how do I motivate others?

Career Anchors / Career Choice

CV's, Applications and Job Search

Personal SWOT analysis (in pairs)

Setting Broad Career Aims (in pairs and going forward)

Timing of Training

Second Year

Approximate Length of Programme

1 day

Compulsory/Optional

Compulsory

Leadership Skills

Aims

- To provide a definition and overview of leadership
- To help delegates identify the skills and personal qualities which make up their particular leadership style.
- To identify the key characteristics and personal qualities of successful leaders.
- To explain the principles of situational leadership and the importance of motivation and develop strategies for increasing leadership effectiveness.
- To maximise individual and team development.
- To appreciate individual roles and dynamics of cohesive, capable teams.
- To help individuals to further develop their leadership skills.

Typical Programme

Day 1

Welcome and Introductions

Leader or Manager

- What makes a good leader?
- Leadership stereotypes – selecting a leader

Leadership qualities

Leadership Models and Styles and Motivation

Action Centred Leadership

Action Plan

Day 2

Leadership

- Trials and tribulations
- Strategy, communication, delegation, motivation

Conclusion and evaluation

Action Plan

Time of Training

Second Year

Approximate Length of Programme

1½ days

Compulsory/Optional

Optional

Managing Your Project, Managing Your Time

Aims

By the end of this workshop, participants should be able to:

- To identify the methods and techniques for using time more effectively
- To learn how to organise priorities and time
- To understand more fully the best way to manage themselves
- To be better able to handle the multi demands made on their time each day
- To help build greater confidence when working with others

Typical Programme

Welcome and Introductions

Aims and objectives of the course

Calculate your worth

Divide up your time

The principles of good project management

Visualising your plan and communicating it to others (project management terms and techniques)

Planning a research project

Severity of risk

Planning your time

Organising your time

Time management systems

Needless rework

Managing upwards

Timing

Induction

Approximate Length of Programme

½ day

Compulsory/Optional

Compulsory

Equality and Diversity Awareness Seminar

Example Programme

Objectives:

Diversity and the Law

- To consider what is meant by Equality and Diversity
- To consider why Diversity is important to the research councils
- To provide participants with a brief outline of the relevant diversity legislation
- To make aware and discuss diversity issues which need to be considered in the context of relevant legislation

Changing Behaviours and Attitudes for True Diversity

- To understand how we as individuals need to behave relative to others

Diversity Policies

- Understand the diversity policies and their aims.
- Be aware of other policy areas affected.
- Know where to seek advice.
- Understand your rights and roles and responsibilities

Key Skills in Diversity Issues

- To remind ourselves of the importance of good communication when dealing with diversity issues.

Open Discussion

Timing of Training

Induction

Approximate Length of Programme

½ day

Compulsory/Optional

Compulsory

Harassment Awareness – Building Positive Relationships

Aims

- To increase awareness and knowledge of harassment as a form of discrimination.
- To help identify unacceptable behaviour and also ensure that personal behaviours do not constitute harassment.
- To increase understanding of the Harassment policies of the BBSRC and the Institute.

Typical Programme

Introduction and objectives of the course

Why is this briefing important now?

Overview of the Babraham policy

What is harassment?

- Behaviour
- Effects on people and the workplace

The Institute's approach to dealing with harassment

- Informal
- Formal

Harassment situations

- Syndicates working on case studies
- Discussion of key learning points

Summary and conclusions

Timing of Training

Induction

Approximate Length of Programme

½ day

Compulsory/Optional

Compulsory

How to write a CV and perform well at Interviews

This course is run in-house by an external provider and is geared towards young scientists looking for their first post following their PhD studies.

Aims

The course is divided into two parts - compiling a CV and preparing and going through the recruitment process. It is an interactive course which gives practice at performing within an interview situation.

Typical Programme

- | | |
|------------------|--|
| Compiling a CV | <ul style="list-style-type: none">- Preparation, style and layout, format and content, references- Different types of CVs- Covering letter |
| Interview Skills | <ul style="list-style-type: none">- Different types of interviews- Before the Interview - preparation- On arrival – do's and don't's- The Interview – behaviour and attitude, answering questions, asking questions, making an impression- Tests and assessment tools (aptitude, personality)- Assessing offers |

<u>Timing of Training</u>	Third Year
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<u>Approximate Length of Programme</u>	1 day
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<u>Compulsory/Optional</u>	Optional
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Computer Skills Courses Microsoft Office

All students complete self assessment forms covering the range of Microsoft Office products including Outlook, Word, Excel, PowerPoint and PhotoShop Elements.

Listed under each of the following packages are the typical areas covered at the basic, or introductory level, and the intermediate level. Individual topics may differ depending on the delegates' knowledge and courses are tailored to each group's experience and needs.

Outlook – Introduction (Part of Induction Course in first week)

Starting Outlook
The Outlook Bar
Adding Groups and Folder
Communicating with Others
Contact Lists
Tasks Lists
Integration with other Microsoft Office Programs
Managing Mail using Auto-Assistants
Closing Outlook

Outlook - Intermediate

Managing Your Time
Co-ordinating Calendar and Task Lists
Shared Calendars
Managing your Work
Archiving
Advanced Techniques

MS Word – Basic

Screen/Toolbars
Creating, saving, previewing and closing a document
File management
Enhancing the appearance of text
Manipulating text
Editing a document
Setting tabs
Find, search and replace information
Primary paragraph numbering and bullet points
Automatic data
Line spacing
Spell check, thesaurus and grammar check
Autocorrect
Alternative keyboards
Printing
Help files

MS Word – Intermediate

Borders
Table and Newspaper columns
Headers and Footers
Styles
Drawing (Word Art; importing ClipArt and other graphics; capturing screen pictures)
Autotext
Mail Merge (combining Word letters with Excel or Access databases)
Mailing labels
Templates
Revisions, Book Marks and Annotations
Introduction to Automation using Macros

Excel – Basic (Part of Induction Course)

Getting started
Designing a spreadsheet

- correcting an entry
- saving the sheet on a disk
- formatting Cells
- copying
- variable Names

General Spreadsheet Design
Creating Charts
Built-in Functions
Databases in Excel

Excel – Intermediate (Part of Induction Course)

A recap of basic facilities of Excel
Spreadsheet presentation - boxes, shading, colour
Using Variables in Formulae
Cell protection, Sheet protection and Workbook protection
Built in Functions
Modifying Excel Charts
Designing and Documenting Spreadsheets
Building and Searching Databases in Excel
Sorting Tables
Linking data on several worksheets

Access 2002 – Basic

What is a database
The initial Access screen
To open a database
Inspect a table containing data
Return to the database view
Viewing table records via a form
Look at a related table
Forms containing pictures
To print a report
To close a database
Creating a new database and table
Adding new records to the table

To print the table
Modify the table structure
Create a simple input form
Print the date in the form format
Produce a report summarising the pledges
Using filters to extract records and to sort
Querying the database
Multi-table queries

Access 2002 – Intermediate

A recap of basic Access facilities
A brief introduction to Entity Modelling - Entities and relations & Normalised relations
Theory of building a good database
Looking at existing Database Application with Multiple Tables
Building a Multi-Table Database
Setting up Relationships and Referential Integrity
Forms, Reports and Queries based on Multiple Tables
Parameterised Queries
Forms and Sub-Forms

PowerPoint and Office Integration

What the presentation software is used for
Starting and quitting PowerPoint

- autocontent Wizard
- tools available
- slide (page) setup
- typefaces and point size

Text, drawing objects and clipart

- text insertion
- inserting drawing objects
- inserting clipart

How to show a PowerPoint presentation on the computer
View the presentation in a variety of ways

- Single Slide; Slide Show; Outline View; Slide Sorter View; Notes Pages View

Customising a Slide Presentation

- transitions
- builds
- timing of your presentation

Use of PowerPoint for Posters or Flyers

- design principles
- layout
- use of colour
- use of clipart
- use of watermarks
- advertise yourself

Use PowerPoint's online help facilities
Modify PowerPoint's toolbar display
How to integrate PowerPoint with other Microsoft Office applications

PhotoShop Elements (Part of Induction Course)

Basic Theory
The Working Environment
Opening and Saving Files
Getting Started with Images
Defining Colours
The Painting Tools
The Editing Tools

Welcome to the Graduate School of Life Sciences

<http://www.biomed.cam.ac.uk/gradschool/current/>

The Graduate School is likely to have a considerable impact on you as a post-graduate student. The purpose of this and other documents (which you should also have received in your paper welcome package) is to make you aware of the facilities it offers, and how you might benefit from its resources during your time here.

Your School

The Graduate School of Life Sciences includes both University Departments and affiliated Institutes. All post-graduate students registered for a University degree in these Departments and Institutes are automatically members of the School. Within the University, the School covers the Faculties of Biology, Clinical Medicine, and Veterinary Medicine. It includes the Wellcome Trust/Cancer Research UK Gurdon Institute, the Cambridge Institute for Medical Research, the Wellcome Trust Centre for Stem Cell Research, the Cancer Research UK Cambridge Institute and the Institute of Metabolic Science. The Babraham Institute, MRC Laboratory of Molecular Biology, MRC Mitochondrial Biology Unit, Wellcome Trust Sanger Institute and the European Bioinformatics Institute are among other institutes that are affiliated. A full list is shown on [our web site](#). There are about 1,500 graduate students in all.

Your training

As a major international research University, Cambridge invests a great deal in training research students, and naturally your main focus as an MPhil or PhD student will be upon the specialist subject of your research. Many of the outstanding publications from Cambridge are based on work by graduate students.

We aim to provide all our students with a supportive and stimulating research environment. There is a carefully monitored supervision system and a wealth of seminars and other research-oriented teaching. However, we also recognise the importance of more general training to develop and enhance other professional and transferable skills, and all students attend individually tailored programmes of courses that enhance their background scientific knowledge, as well as providing information on subjects essential for future career development. Transferable skills training may be achieved by means of formal course attendance, as an integral part of the research training and monitoring programme, and via voluntary activities such as teaching undergraduates, or participation in Science Week. Training is recorded in a Personal Progress Log.

Your courses

The Graduate School co-ordinates a broad portfolio of transferable and professional development skills courses specially designed for graduates; these form an essential part of modern graduate education. You will find courses that:

- help you strengthen your specific research skills
- help you obtain skills that help other, more general (but equally important), aspects of your work
- help you think about topics that must concern anyone beginning research training (e.g. the ethics of research, public attitudes to research, public policy decisions etc)
- help those of you who want to teach undergraduates (both seminar teaching and laboratory demonstrating)
- help you plan and advance your future career by considering entrepreneurship, issues of intellectual property, how to present yourself to a potential employer, opportunities in industry or academia, etc.
- give you extra opportunities to meet graduate students from other departments or the affiliated institutes.

You will find information on much of this on the [course web pages](#)

Each month you will receive an e-mail Newsletter, which will tell you about upcoming courses and new developments in graduate training, as well as other matters, which you may find interesting and helpful. Read it carefully, or you may miss out!

Your Progress Log

All graduate students are required to keep a [Personal Progress Log](#), which should be an up to date record of your training needs and requirements as a Graduate Student. Its purpose is to help you to plan your own and to record the outcomes. The information accumulated will also prove helpful when you come to rewriting your CV and applying for jobs. The document belongs to you and it is your responsibility to keep it up to date. Your Log is usually presented to your Department as a required part of your First Year Report.

The Experts

The website also hosts the [Experts Directory](#) which allows you to locate and consult a large number of experts in the University and its affiliated Institutes. If you have a problem with your research that neither your supervisor nor your adviser (mentor) can resolve then this might be just what you need. Currently, the Experts Directory includes about 300 people available to answer questions in a wide range of fields, searchable by keyword.

The School is for you

Remember: the Graduate School is only as good as you make it. You will find online forms on the web site, not only to book courses, register with the Students Forum or use the Experts Directory, but also to [tell us](#) about the things you want. You will also be asked to fill in forms so we get feedback on the quality and amount of the training you receive. It is essential that we hear from you.

Who's who

We urge you to take time to get to know the names of people who may be important to you. Of course, your supervisor and adviser (mentor) are the most prominent, but the Chair of your Departmental/Institute Graduate Education Committee (DGEC for short) is likely to have a major role in running graduate education in your department/institute), and is a name you will need to know. Formal responsibility for admissions, supervision, examinations and awards lies with the Faculty Degree Committees. If you are in a biological department, then the Chair of your [Degree Committee](#) is Dr Geoff Cook (Physiology, Development and Neuroscience; for [Clinical Medicine and Veterinary Medicine](#) it is Dr Hugh Field (Veterinary School). The current Chair of the Graduate School and members of the [School's Graduate Education Committee](#) are listed on the web site. The administrator of the Graduate School is [Dr Laurie Friday](#). The new Skills Training Officer is Dr Geraint Wyn Story. Outside the Graduate School, your College Graduate Tutor is someone who can be a real help (e.g. with finances for fieldwork or conferences), so make sure you know who he/she is, and make a point of meeting him/her.

There are also three graduate student/postdoc representatives on the Graduate Education Committee: Lorina Naci (lorina@csl.psychol.cam.ac.uk), Faculty of Biology, Gary McDowell (gsm26@cam.ac.uk), Faculty of Clinical Medicine, and Joanna Knaggs (jck2@cam.ac.uk) Faculty of Veterinary Medicine.

You are starting out on a new and exciting time here. We hope (and expect) that you will enjoy life in Cambridge. We look forward to hearing directly from you about your experiences as a graduate student in research at one of the great universities of the world.

A very warm welcome indeed.

Introduction to courses

<http://www.biomed.cam.ac.uk/gradschool/skills.html>

The courses available from the Graduate School and other course providers in the University form the basis of a programme which will run over the three or four year study period of your (PhD) graduate research programme. Those following a one or two year (MPhil or MSc) course are equally welcome. Most courses are also suitable for postdocs and some are specifically designed for postdocs (especially Careers Service courses and events). The University Safety Course at the beginning of the academic year is compulsory for all students. The Graduate School has its own new **compulsory course** for all new graduate research students. Otherwise, no courses are compulsory for all students and you can tailor your attendance at courses to your specific needs. Your department may have its own compulsory courses, and this will be explained to you by your department.

All graduate students should attend a range of courses; the number and time deemed necessary is flexible, but should *average* about one half-day per week. Research Council funded students and postdocs are now expected to engage in about two weeks (ten days) a year transferable skills training, which may include activities such as giving a poster or seminar as well as attending some of the taught sessions listed on this web site or given in your department. We encourage all researchers to aim at this amount of training. You can read the [Research Councils' skills requirements](#) and a [student's comments](#) on how time on courses is time well-spent.

For graduate students a [credit system](#) for attendance at courses and participating in other training activities has been provided. The [Student Log Book](#) helps students record their accumulated credits. At present postdocs are not required to keep a logbook.

We encourage you to discuss attendance at courses with your supervisors/research group leaders. Also note that if students do sign up for a course, they will be assumed to have attended it (eg by their examiners and by their Departmental/Institute Graduate Education Committee). You should record all your training in your Log Book.

Think carefully before you choose to go on a course. Your time is valuable, and so is that of whoever is running the course! There are courses on [transferable and general research skills](#) and there is [subject-specific research training](#). There is some overlap between these two groupings and you gain credit for attending both. You may want to attend some [Part II lectures](#) to fill in gaps in your knowledge and certainly some [departmental seminars](#). Details of the [credits](#) for all types of course have been provided for students. Before registering for a course it is worth bearing the following points in mind:

1. After discussing graduate training needs with your supervisor (and, perhaps, your adviser) choose a selection from the range of courses available. Remember that graduate training is a very individual affair and each graduate student will follow his/her own set of courses. This is even more the case for postdocs.
2. Remember to plan your research work and your course schedule so that the one does not interfere with the other. Make sure that, if you sign up for a course, you are not prevented from attending by having to be in the lab (or away from Cambridge for any reason).
3. Remember: course work is important. You are now expected to have a range of skills that go beyond your experimental work and these can only be gained from attending the right mix of courses.

If you find you can't attend a Graduate School course that you have booked, you MUST let us know AT LEAST 2 WORKING DAYS before it starts (that means 4 DAYS if a weekend is included). You are told how on the booking form and email confirming your place. The same applies elsewhere. Non-attendance at courses wastes time and money and is off-putting for those giving the courses. You may also deprive someone else of the chance of attending. Please take your commitments seriously. The courses may appear free to you but they actually cost a lot to provide.

Timetable of courses and lectures

<http://www.biomed.cam.ac.uk/gradschool/current/courses/timetable.html>

In the top two sections below are links to course providers who have extensive programmes most of the year, who provide their own timetables. At the bottom are details of specific forthcoming courses, mostly in the Graduate School, and selected lectures. The other pages on the courses web site have additional information e.g. about online materials and courses that have been held in the past (ie which will probably be scheduled again this year). The [transferable and general skills page](#) groups courses by types of skills while the [subject based skills page](#) attempts to list science topics in alphabetical order; there is deliberately some overlap to help you find what you want. Note the courses are usually not continuous between the dates shown: they may only be one hour or so per week. See the course web pages for more details. Not all courses are shown here yet. More information will be added and you will get details via the email newsletter.

Transferable and general skills providers

[Careers Service](#): Graduate students and postdocs; register to view diary

[Computing and IT courses](#) (Computing Service) Most days in Full Term (plus Long Vacation; also teach-yourself courses)

[E-learning transferable skills courses provided by the University](#)

[Electronic resources \(University Library\)](#) Most of the year

[Entrepreneurial Learning, Centre for Enterprise](#) Tuesday October onwards, and other courses

[Graduate Union](#): Transferable skills and social events

[Home Office Licence training](#) All year

[Language Centre courses and resources](#)

[Personal and Professional Development](#): Courses for postdocs and graduate students

[Public communications courses and opportunities](#)

[Safety courses](#) All year

[Vitae Programmes \(National\)](#) All year

See also the [transferable skills page](#) for listings by topic, and online materials.

Science courses and seminars

[Biochemical and molecular biological techniques](#) [Links to slides in CamTools]

[Cancer](#)

[Cellular neuroscience](#)

[Cognitive and brain sciences](#)

[Core Course in Developmental Biology and Stem Cell Biology](#)

[Experimental Approaches in Developmental Biology seminar series](#)

See the [subject based skills page](#) for more courses and techniques training opportunities.

See the [Seminars page](#) for lists of seminars by department/subject.

Highlighted forthcoming courses and lectures

[CCPN programming for computational NMR](#)

[Perl programming](#) 1st – 3rd December 2010

[A beginners guide to R](#)

[Local GRADschool](#) September 2010, April 2011, September 2011

[Protein databases and tools](#) 20th-21st September 2010

[Microarray data analysis \(GEPAS\)](#) 29th September – 1st October 2010

[Molecular evolution and phylogenetics](#) Course offered 2-3 per year

[Browsing genes and genomes with Ensembl](#) Course offered 3-4 times per year

Joint Statement of the Research Councils'/AHRB'S Skills Training Requirements for Research Students

http://www.biomed.cam.ac.uk/gradschool/current/courses/skills_training.html

Introduction

The Research Councils and the Arts and Humanities Research Board play an important role in setting standards and identifying best practice in research training. This document sets out a joint statement of the skills that doctoral research students funded by the Research Councils/AHRB would be expected to develop during their research training.

These skills may be present on commencement, explicitly taught, or developed during the course of the research. It is expected that different mechanisms will be used to support learning as appropriate, including self-direction, supervisor support and mentoring, departmental support, workshops, conferences, elective training courses, formally assessed courses and informal opportunities.

The Research Councils and the AHRB would also want to re-emphasise their belief that training in research skills and techniques is the key element in the development of a research student, and that PhD students are expected to make a substantial, original contribution to knowledge in their area, normally leading to published work. The development of wider employment-related skills should not detract from that core objective.

The purpose of this statement is to give a common view of the skills and experience of a typical research student thereby providing universities with a clear and consistent message aimed at helping them to ensure that all research training was of the highest standard, across all disciplines. It is not the intention of this document to provide assessment criteria for research training.

It is expected that each Council/Board will have additional requirements specific to their field of interest and will continue to have their own measures for the evaluation of research training within institutions.

(A) Research Skills and Techniques - to be able to demonstrate:

1. the ability to recognise and validate problems
2. original, independent and critical thinking, and the ability to develop theoretical concepts
3. a knowledge of recent advances within one's field and in related areas
4. an understanding of relevant research methodologies and techniques and their appropriate application within one's research field
5. the ability to critically analyse and evaluate one's findings and those of others
6. an ability to summarise, document, report and reflect on progress

(B) Research Environment - to be able to:

1. show a broad understanding of the context, at the national and international level, in which research takes place
2. demonstrate awareness of issues relating to the rights of other researchers, of research subjects, and of others who may be affected by the research, e.g. confidentiality, ethical issues, attribution, copyright, malpractice, ownership of data and the requirements of the Data Protection Act
3. demonstrate appreciation of standards of good research practice in their institution and/or discipline

4. understand relevant health and safety issues and demonstrate responsible working practices
5. understand the processes for funding and evaluation of research
6. justify the principles and experimental techniques used in one's own research
7. understand the process of academic or commercial exploitation of research results

(C) Research Management - to be able to:

1. apply effective project management through the setting of research goals, intermediate milestones and prioritisation of activities
2. design and execute systems for the acquisition and collation of information through the effective use of appropriate resources and equipment
3. identify and access appropriate bibliographical resources, archives, and other sources of relevant information
4. use information technology appropriately for database management, recording and presenting information

(D) Personal Effectiveness - to be able to:

1. demonstrate a willingness and ability to learn and acquire knowledge
2. be creative, innovative and original in one's approach to research
3. demonstrate flexibility and open-mindedness
4. demonstrate self-awareness and the ability to identify own training needs
5. demonstrate self-discipline, motivation, and thoroughness
6. recognise boundaries and draw upon/use sources of support as appropriate
7. show initiative, work independently and be self-reliant

(E) Communication Skills - to be able to:

1. write clearly and in a style appropriate to purpose, e.g. progress reports, published documents, thesis
2. construct coherent arguments and articulate ideas clearly to a range of audiences, formally and informally through a variety of techniques
3. constructively defend research outcomes at seminars and viva examination
4. contribute to promoting the public understanding of one's research field
5. effectively support the learning of others when involved in teaching, mentoring or demonstrating activities

(F) Networking and Teamworking - to be able to:

1. develop and maintain co-operative networks and working relationships with supervisors, colleagues and peers, within the institution and the wider research community
2. understand one's behaviours and impact on others when working in and contributing to the success of formal and informal teams
3. listen, give and receive feedback and respond perceptively to others

G) Career Management - to be able to:

1. appreciate the need for and show commitment to continued professional development
2. take ownership for and manage one's career progression, set realistic and achievable career goals, and identify and develop ways to improve employability
3. demonstrate an insight into the transferable nature of research skills to other work environments and the range of career opportunities within and outside academia
4. present one's skills, personal attributes and experiences through effective CVs, applications and interviews

Transferable and general research skills

<http://www.biomed.cam.ac.uk/gradschool/skills/trans-courses.html>

This page gives details of courses in transferable and general research skills available from the Graduate School and links to other course providers in the University and elsewhere. It also has links to online resources. There is a new University Skills Portal that may also contain other interesting options. Using this portal you can do a simple online assessment that can help guide you towards courses of relevance to your needs.

University skills portal

To find out more details about a particular course, please follow the links.

You will also receive e-mail newsletters alerting you to updated information and new courses.

Once you have made your course choice(s), and noted any reference number given, simply complete the course **booking form** where applicable.

In many cases you will be directed to other web sites with their own booking systems. It is often the case that the course providers can offer similar courses to those provided through the Graduate School so you may be able to find a date that suits you better. Sometimes the Graduate School course is more targeted at Life Sciences but you can still benefit from the alternatives. The alternatives include online courses.

CAREER PLANNING, BUSINESS SKILLS AND PERSONAL DEVELOPMENT

- Starting your PhD
- Completing your PhD
- Project Management
- Careers Service
- Centre for Personal and Professional Development
- Local GRADschools
- Online talks/resources about getting a fellowship
- Centre for Entrepreneurial Learning
- Entrepreneurship, CfEL
- Management of Technology and Innovation modules: **NEW**
- Accounting and finance
- Commercialising science
- Decision analysis
- Marketing
- Microeconomics
- Organising for innovation
- Strategy for technology-intensive organisations
- Cambridge University Entrepreneurs Business Competitions
- [Researchers in Residence](#) Gain teaching experience in a school
- [STIMULUS](#) Peer assisted learning (PAL) through visits to schools
- E-learning courses include [Project management](#)
- [Vitae](#) programme (national)
- [Graduate Union](#) runs some transferable skills and other sessions

COMPUTING AND INFORMATION TECHNOLOGY

• A very wide range of courses is run by the [University Computing Service](#).

You can book all these via their [online booking system](#)

A selection from the current list of taught course topics is:

- Basic skills, Macintosh, Windows, Email
- Word/text processing, Desktop publishing, Presentation software (Word/Powerpoint)
- Bibliographic software (Endnote), Spreadsheets (Excel), Databases (Access, Filemaker Pro)
- Graphics and photo/image processing (Illustrator, Photoshop etc)
- Programming (C, Fortran, Python, PERL etc)

COMMUNICATION SKILLS

- Communication skills
- Public communication: [Rising Stars](#) course
- Other public communications opportunities
- Scientific writing
- Presentation Skills
- How to make a poster
- Keeping a lab notebook
- Supervising and small group teaching
- Laboratory demonstrating
- Centre for Personal and Professional Development
- Language Centre
- How to write your dissertation
- Dissertation guidance from the Graduate School
- Online guides to writing, giving presentations and preparing posters
- Writing research grant applications (Professor Anne Cooke's ppt slides)
- Faculty of Biology advice on supervising and other teaching related matters
- E-learning courses include [Getting published](#)

GENERAL TOPICS

- Bioethics
- [Cambridge Enterprise](#) Information about University IP policy
- Design and analysis of Experiments, Dr Ed Tanner
- Training for applicants for Home Office Licences (throughout year)
- Health and Safety Division
- E-learning courses include [Research ethics and Intellectual property](#)
- Statistics courses:
 - [Conducting Research: Understanding and interpreting statistical evidence](#), Dr Chris Palmer
 - [Centre for Applied Medical Statistics](#) A range of courses (low fees for students)
 - [Statistics Seminars at MRC-CBU](#)
 - [Statistics for graduate biologists](#), Dr Brian McCabe
 - [Multivariate statistics](#)

- Statistical and mathematical software (SPSS, Stata, MATLAB, Mathematica)

You will also see on the web site that there are teach yourself courses you can borrow. These may cover the same or additional material and allow you to work in your own time. Check the list of [Course Topics](#).

- [Bioinformatics: various courses](#)
- [University Library: Courses on electronic resources](#)
- [Managing your bibliography](#)
- [Pubmed and Endnote](#)
- [Web of Science and Scopus](#)
- [Google and Google Scholar](#)
- Many departments also run introductions to literature searching etc.: ask your departmental librarian for help

- [See also IA Introduction to the Scientific Basis of Medicine](#)
- [IA Quantitative Biology](#)
[IA Elementary Mathematics for Biologists](#)
- [MPhil in Statistical Science](#)
- [Online Statistics Tutorials](#)
- [Online course in R for Spatial Analysis \(Spring 2009\)](#)

Subject based skills

<http://www.biomed.cam.ac.uk/gradschool/current/courses/res-courses.html>

This page gives details of training courses in research methods and series of seminars for graduate students and others, available from the Graduate School and other course providers. You will also wish to consult the lists of [departmental seminars](#).

To find out more details about a particular course, please follow the links. Some short courses will be re-advertised nearer the time they next run. Some long courses that are advertised may finish in early summer or spring but start again in October.

- [Biochemical and molecular biological techniques lectures \(Slides\)](#)
- [Biocomputing workshop 24th June 2010](#)
- [Bioinformatics hands-on courses](#)
- [Cancer seminars and lectures](#)
- [Computing and IT lectures/hands-on courses](#)
- [Flow cytometry training \(Starts again October 2010\)](#)
- [Home Office Licence training](#)
- [Imaging and microscopy training](#)
- [Infection and immunity lectures](#)
- [Infectious diseases training](#)
- [Mathematical approaches in biology \(Slides\)](#)
- [Neuroscience, cellular, lectures and workshops \(Finished\)](#)
- [Neuroscience: cognitive and brain sciences seminars](#)
- [Neuroscience, crash course in \(Slides\)](#)
- [Neuroscience, journal club](#)
- [Statistics and maths courses and advice \(various levels\)](#)

Useful lecture courses

<http://www.biomed.cam.ac.uk/gradschool/current/courses/partii.html>

Students usually find it helpful to attend some advanced undergraduate courses (Part II). There are also a range of MPhil courses and graduate courses in other Schools including lectures that may be of interest to some students. For other students foundation (IA) courses may be helpful, e.g. in maths and statistics, as listed on the [Transferable skills](#) page.

PDF copies of all the timetables for both the Natural Sciences Tripos (NST) and Medical Sciences Tripos (MVST) will be in the [University Reporter](#) Special Numbers. You will need to download the PDF files that are listed by Faculty and/or by Tripos/subject. You will also find in here other courses such as the MPhil in Computational Biology, MPhil in Statistical Science, MPhil in Quaternary Science etc.

In addition departments offer fuller descriptions of the courses on their own web sites, which you can find using the links below.

- [Anatomy Teaching](#)
- [Biochemistry Teaching](#)
- [Computational Biology MPhil](#)
- [Engineering for the Life Sciences](#)
- [Environmental Science MPhil](#)
- [Experimental Psychology Teaching](#)
- [Genetics Teaching](#)
- [Medical and Veterinary Sciences Part II](#)
- [Neuroscience Part II](#)
- [Pathology Teaching](#)
- [Pharmacology Teaching](#)
- [Physics of Living Matter](#)
- [Physiology, Development and Neuroscience Teaching](#)
- [Plant Sciences Teaching](#)
- [Statistical Science MPhil](#)
- [Systems Biology Part III \(NEW\)](#)
- [Zoology Teaching](#)

Regular series

<http://www.biomed.cam.ac.uk/gradschool/current/seminars.html>

- Cambridge Society for the Application of Research
- Babraham Institute
- Behavioural neuroscience
- Behaviour, Ecology and Evolution
- Biochemistry
- Bioinformatics joint CRI-BSU series
- Bioinformatics journal club for the omics
- European Bioinformatics Institute
- Cambridge University Biological Society
- MRC Biostatistics
- Cambridge Centre for Brain Repair
- Cancer
- Wellcome Trust/Cancer Research UK Gurdon Institute
- Cavendish Laboratory (Physics)
- Cell Biology
- Computational Biology
- Cognitive and Brain Sciences (Graduate)
- Cognitive and Brain Sciences (Lunchtime)
- Developmental biology
- Developmental biology and neuroscience
- Disease Mechanisms
- Ecology
- Evolution
- Evolution and Development
- Experimental Psychology
- Centre for Family Research
- Genetics
- History and Philosophy of Science
- History of Population and Social Structure
- MRC Human Nutrition Research
- Immunology

- [Infectious disease](#)
- [Institute of Metabolic Science](#)
- [MRC Mitochondrial Biology Unit](#)
- [MRC Laboratory of Molecular Biology \(See Seminars and Events\)](#)
- [Molecular Informatics](#)
- [Nephrology, Immunology & Transplantation](#)
- [Neuroscience](#)
- [Pathology: Histopathology Division](#)
- [Pathology: Immunology Division](#)
- [Pathology: Microbiology and Parasitology Division](#)
- [Pharmacology Tea Club](#)
- [Cambridge Philosophical Society](#)
- [Physiology, Development and Neuroscience](#)
- [Plant Sciences](#)
- [Psychiatry](#)
- [Psychometrics Centre](#)
- [Cambridge RNA Club](#)
- [Wellcome Trust Sanger Institute](#)
- [Cambridge University Scientific Society](#)
- [Social and Developmental Psychology](#)
- [Stem Cell and Leukaemia](#)
- [Strangeways Laboratory](#)
- [Veterinary Medicine](#)
- [Virology](#)
- [Zoology](#)

Other seminar lists

- [Talks.Cam Life Sciences list](#) New service to show all seminars. Needs more departments to add their seminars to make it really useful: get yours to join!
- [University wide lists of seminars](#)

Meetings and Courses

- Courses are advertised on our [courses web site](#)
- Other news of seminars and meetings is on our [advertisements page](#)

A student's view of courses

<http://www.biomed.cam.ac.uk/gradschool/current/courses/student-view.html>

Many sponsors, particularly the UK Research Councils, as well as employers require graduate students not only to have a good research education, but a set of professional transferable skills that will equip them for a wide range of careers. As part of your post-graduate education, you are required to spend at least ten days a year engaged in transferable skills training, regulated by a credit system. Much of this training will be based in your department, and includes such activities as giving seminar and poster presentations, scientific writing, and safety inductions, but you will also be required to participate in formal training outside your department.

The Graduate School co-ordinates a broad portfolio of transferable and professional development skills courses that are not available to students elsewhere within the university. These courses are a significant addition to our PhD training, providing breadth and adaptability in your chosen profession. The wide range of courses begins with a compulsory *Introductory Course* and includes both courses that can help you directly as you work on your PhD, such as "Starting Your PhD", "Keeping a Lab Notebook", and statistics courses, and courses that help you expand your range of skills outside the lab environment, such as "Supervising and small group teaching" or an introduction to entrepreneurship. You should take advantage of courses provided elsewhere within the University by the Computing Service, the Centre for Personal and Professional Development and the Language Centre, and of course the wide range of lecture courses.

Some students may think that a couple of hours or a day away from the laboratory is time wasted. It is not. These courses are valuable to you and are part of your post-graduate training. Only by taking full advantage of these opportunities available to you can you get the most out of your time in Cambridge. Read the Graduate School's monthly email newsletter, and check the website regularly to keep yourself up-to-date with the courses offered.

"In the first 18 months of my PhD studies I've attended numerous courses provided by the Graduate School and by the Computing Service. These courses have covered topics ranging from specific research skills (eg Microarrays, Keeping a Lab Notebook) to the effective use of computer software (eg Endnote, Photoshop and Microsoft packages) to general personal development skills for 'life-after-university'. I can honestly say that every course I've attended has been time very well spent.

For example, in a one-hour talk on Intellectual Property I became aware of some concerning ways in which I had been failing to protect my IP. I also came away with many questions that I have since pursued answers for. Often you think you know about a topic until you attend a course about it - then you find out just how much you didn't know!

I also gained a lot from the course focused more on general skills, such as creative thinking, which can be applied in a variety of situations and will assist in the development of a rewarding career when studies are completed. The tutors challenged us to identify our strengths and weaknesses and really highlighted some aspects of my personality that I had suspected but didn't ever expect to see so clearly! I didn't necessarily agree with everything the courses suggested but that in itself is useful insight.

The courses run by the Computing Service have always impressed me with the level of professionalism and the provision of excellent course materials and exercises. These courses not only taught me how to use programmes such as Excel, Access and Photoshop but have led me to think about how I can use these and other software tools to aid my research. This has allowed me to organise and analyse my research data more easily and I have also found other applications for these programmes that assist me on a day-to-day basis. Most days I use some skill I have learned at a Graduate School or Computing Services course.

One of the wonderful things about this university is that we are provided with excellent opportunities to learn the skills we need. If you're here to get an education, don't forget that attending courses can be an important part of that quest"

Wendy Brooks, PhD Student

You should consult your [Student Log](#) for more information about how to organise and record your transferable skills training and the courses and other opportunities available to you.



About Vitae (reproduced from Vitae web page)

<http://vitae.ac.uk/1274/About-Researcher-portal.html>

Vitae is a national organisation championing the personal, professional and career development of doctoral researchers and research staff in higher education institutions and research institutes.

We play a major role in the drive for high-level skills and innovation and in the UK's goal to produce world class researchers.

Our vision is for the UK to be world-class in supporting the personal, professional and career development of researchers.

To achieve our vision we have four main aims:

- Championing the development and implementation of effective policy
- Enhancing higher education provision through sharing practice and resources
- Providing access to development opportunities and resources
- Building an evidence base to support the researcher development agenda

Vitae builds on the work and activities of the UK GRAD Programme for postgraduate researchers and [UK Higher Education Researcher Development \(UKHERD\)](#) network for research staff. Vitae is funded by the [Research Councils UK \(RCUK\)](#) and managed by [CRAC: The Career Development Organisation](#) and delivered in partnership with regional Hub host universities.

By working together with higher education institutions and research institutes, we provide specific support for doctoral researchers and research staff. We also champion the common needs and interests of all researchers.

We work with those committed to developing the potential of researchers, including national and international organisations, government, funders of research, universities and other employers of researchers, and researchers themselves.

National GRADschools 2010

<http://vitae.ac.uk/researchers/15749/National-GRADschools-2009.html>

GRADschools have continually evolved since 1968 to become one of the flagship training and development programmes for postgraduate researchers, providing the foundation for approaches to programme and resource development undertaken by both Vitae and the sector.

'Our vision is to create an inspirational, challenging and experiential learning environment in which all participants will learn something new about themselves and take away skills, tools or information which will motivate them to complete their studies, further realise their potential, and enable them to make more informed choices about their future careers.'

Overview

In 2010 Vitae are running 3 National GRADschools, each of which will be:

- a 3 day residential course
- involve at least half a day of outdoor activities
- open to all postgraduate researchers in the 2nd year and above from any institution, discipline and age range

For more information on what is involved in taking part on these, please see our section on [GRADschools](#).

'It has probably been the best personal/life development course I have ever done.'
Participant, Ambleside 3, 2008

What else do I need to know?

Liability

Researchers who attend GRADschools enjoy the energy and informal approach of the courses. However they are intensive and we ask you to consider this when applying. Whilst on course we also ask that you look after yourself, your energy levels and each other.

Who should apply?

National GRADschools are open to all postgraduate researchers in their 2nd year or above. If you are research council funded you will be eligible for a funded place on a GRADschool subject to availability.

If you are a non-research council funded researcher you may apply for a national GRADschool but you or your institution will need to cover the cost of your place and you will need to provide invoice details.

Once you have received a place on a GRADschool your accommodation, meals and course materials are covered. **However you will have to pay for your own travelling expenses.** For more details please see our [eligibility](#) criteria

Availability

Places are limited and are allocated on a first come, first served basis, so please apply as early as possible. There is no priority given to students on last year's waiting list; you will need to reapply.

If you are placed on this year's waiting list you will be offered places as they become available. Where possible waiting list places will be offered to third year students ahead of second year students.

Next Steps

Keep the dates free

Once you have applied and your application is accepted. PLEASE KEEP THESE DATES FREE. Check now that your dates do not clash with a vital conference or seminar. You will receive confirmation of your dates by e-mail. Please keep this in a safe place.

Check your email for additional information

Once you've applied for a GRADschool, you'll receive pre-course information around 3-4 weeks before the course from the course administrator, outlining all of the details. Please check your email regularly and if you have not received the pre-course information 2 weeks prior to the course please contact courses@vitae.ac.uk.

Change in contact details

Please inform us if there is a change of email or contact address as soon as possible at courses@vitae.ac.uk.

Cancellation/transfer conditions

If you cancel less than four weeks before the GRADschool, and are not able to give an acceptable written explanation, you may be charged £100.

Transfers less than four weeks before the GRADschool will only be acceptable under exceptional circumstances.

Eligibility

Any doctoral student in the 2nd year or above is eligible to attend a National GRADschool. GRADschools run at institutions all have specific eligibility criteria; you will need to contact the GRADschool organiser at the institution itself for more information.

If you are an AHRC, BBSRC, EPSRC, ESRC, MRC, NERC or STFC funded student your place on a national GRADschool is FREE subject to availability. Please note that you are only eligible for a free place while you are still receiving research council funding for your PhD.

Royal Society of Chemistry members

If you are a member of the Royal Society of Chemistry there are a limited number of bursaries to cover a place on a course. You will need to fill in an RSC application form before applying through the Vitae website. Please visit the RSC website for [more information and the RSC application form](#).

Wellcome Trust funded students

Funded places are available for final year Wellcome Trust funded students. If you are eligible for a funded place this year you will receive a letter directly from the Wellcome Trust. If you have any questions about eligibility please contact the Wellcome Trust.

Society for General Microbiology members

SGM Postgraduate Student Members, in the penultimate or final year of a PhD, and who are not eligible for a place funded by the BBSRC, MRC, EPSRC, RSC or the Wellcome Trust, may be eligible to apply for a GRADschool grant which covers full cost of course fees of a national GRADschool. Grant applications must be made before registering for a place on a course. More information and application forms are available from the SGM website: <http://www.sgm.ac.uk/grants/Gradschool.cfm>

For postgraduate researchers sponsored by other organisations

You are eligible to attend a national GRADschool at a cost of £580 +VAT for a 3-day course in 2009. Please contact your University department and PhD sponsor to see if they would be willing to support your participation on a GRADschool, by paying either all or part of this cost for you. You will need to fill in the invoicee details when you complete an application.

What do the fees cover?

Fees cover accommodation, all meals and course materials. **We are unable to pay travel expenses so you will need to fund this yourself.**

Example programme

Day 1

Time	Activity	Description
0930	Registration	
1030	Course director's introduction	The course director sets out the aims and objectives of the course; explains how it works and introduces you to the course team who are there to support you.
1100	Team icebreaker	A high energy first exercise introducing you to working with members of your team towards a common goal.
1200	Group objective setting	A session designed to identify and share your individual and group objectives for the week.
1300	Lunch	
1400	Interview workshop	A career management exercise involving preparation for, and participation in, mock interviews for a position of your choice, with the opportunity to discuss interview techniques and receive feedback from peers and tutors.
1830	Dinner	
1930	Group review	Facilitated discussion and activities led by your team tutor designed to help you reflect on the day. This session enables you to identify individual and team progress towards your objectives, useful points or learning and time to action plan for the next day.
2030	Opportunity for informal discussion	

Day 2

Time	Activity	Description
0900	Team development exercises	Short practical indoor or outdoor activities which are designed to enable you to challenge yourself in a safe environment and your team to develop effective ways of working together.
1300	Lunch	
1430	Free time	
1515	Presentation skills	An interactive skills session aimed to introduce you to tools and techniques of preparing and giving effective presentations.
1545	Consultancy case study	A case study exercise set within the context of a management consultancy team. It introduces the aims and challenges of creative and effective problem solving, investigating and understanding the needs of others.
1845	Dinner	
1945	Group review	Facilitated discussion and activities led by your team tutor designed to help you reflect on the day. This session enables you to identify individual and team progress towards your objectives, useful points or learning and time to action plan for the next day.
2045	Opportunity for informal discussion	

Day 3

Time	Activity	Description
0900	Introduction to the day	The course director introduces you to the objectives of the day.
1015	Policy making and debating case study	A case study about public involvement in science and the decisions society has to make as a result of scientific developments. This session is designed to help you explore how to make powerful arguments and present them with passion and conviction to a well informed audience who may have diametrically opposed views.
1315	Lunch	
1445	Action planning	This session is aimed to encourage you to reflect on the learning and to commit to an action plan for personal and career development.
1600	Final group review	An in depth review of the course's activities led by your tutor, designed to help you focus on what you have learned about yourself, as a team and about how you will relate this learning back to your PhD and future career.
1715	Last team challenge	The course director introduces a surprise closing activity.
1815	Dinner	
1915	Director's final review	The course director sums up the course and the learning outcomes achieved in the past few days.

Testimonials

'I feel this is a pivotal point in my life - I now have the self-confidence and skills to hopefully shape my life.'

GRADschools are exceptionally highly rated by attendees. All participants are asked for feedback at the end of the course. The testimonials come from a range of participants: postgraduate researchers of Arts/Humanities and Science, mature researchers, researchers who have participated both in a local or national GRADschools.

New insights

'An entirely new world of possibilities opened up to me and allowed me to follow a career path which I feel will be more rewarding than my original choice.'

'The sense of genuine achievement was very tangible. I can honestly say that the course has changed my attitude to work, research and work colleagues quite fundamentally.'

'Fun. Challenging place to be. Centred my own personal opinions and allowed me to relate those to my PhD without being too cheesy.'

'An antidote to the strains of the last months of a PhD, when you ask what it's all about.'

Skills development

'I surprised myself with what I was actually capable of.'

'I still use the negotiation skills with my staff and boss that I learned on the course.'

'I never thought that I could learn so many things about myself: the way I work and how to improve, in such a short time. Even though I was quite cynical about the whole thing to start with, I realise that it has helped me a great deal.'

Effective research management

'I had become stuck in an experimental rut for too long. The course taught me how to gather everything together and organise myself to get my PhD moving again.'

'It probably made the difference between finishing and not finishing, and certainly made my third year bearable.'

Career management

'It was almost entirely because of the course that I researched, applied for and got my current job. The skills I learned at the school were exceptionally useful at the selection stages.'

'It highlighted the fact that I had already learned skills that were useful across different work areas and helped to show ways in which I could present these skills to a potential employer.'

Personal development

'Time and chance to discover more about myself and feedback really helped - I have a clearer idea of where I want to head in the future.'

'A chance to experience something different, it gave me confidence a chance to meet new people and develop team working skills.'

'I honestly think this is one of the best things I have ever done!'

Motivation

'90 highly disbelieving and cynical students, gathered in a conference room, wondering exactly what we were doing there and how the week ahead could possibly fulfil all the wild claims of the publicity. Five days later we returned home inspired, motivated and bursting with confidence about our abilities and the future.'

'I feel this is a pivotal point in my life - I now have the self-confidence and skills to hopefully shape my life.'

'You don't know you need it until you have done it.'

Teamwork

'It increased my confidence about working in groups with people I didn't already know.'

'Being forced to work as a team with total strangers was great. I'd like to do more of it!'

Meeting other postgraduate researchers

'An enjoyable experience and I hope to keep in contact with the people I met on the course.'

'Great to meet others in similar situations and exchange experiences.'

Overseas attendees

'At the close of the week I realised how many more opportunities were out there, and the innumerable alternatives to academia that existed. This was particularly beneficial to an overseas student such as myself, since we are not exposed to areas other than the discipline that we are groomed in.'

Mature participants

'A week in pleasant surroundings away from work - family & domestic responsibilities, part-time paid employment and PhD studies. An opportunity to consider what you are doing and where you want to be.'

'Maybe as a (chronologically) mature student I approached gradschoools week with a greater than usual mix of interest and scepticism but it turned out to be all the above and more!'

Recharging your batteries

'DON'T LISTEN if you are told you can't afford the time: you can't afford to miss this course.'

'It has been such a good time to be away from everything and take a look at the next steps in my career. I've really benefitted from meeting loads of like-minded individuals and building a real closeness with my group. It's left me refreshed and motivated for my last few months in the lab.'

Useful Definitions and Principles

Correct and Effective Concentrations

This is a reference guide explaining the meaning of various terms and parameters which relate to solutions. Working examples are provided so that the principles behind various calculations may be followed.

The items covered are:

Powers of SI units	2
Units of molecular mass	2
Units of volume	2
Weight per volume	3
Molarity	3
Molar solutions	3
Buffers and pH	4
Buffer solutions	5
Normality	6
Concentration-effect curves	6
Isotonic solutions	8

Correct and Effective Concentrations

Powers of SI units

Multiple	Prefix	Symbol
10^9	Giga	G
10^6	Mega	M
10^3	Kilo	k
10^2	Hecto	h
10	Deca	da
10^{-1}	Deci	d
10^{-2}	Centi	c
10^{-3}	Milli	m
10^{-6}	Micro	μ
10^{-9}	Nano	n
10^{-12}	Pico	p
10^{-15}	Femto	f
10^{-18}	Atto	a
10^{-21}	Zepto	z

Units of molecular mass

The mass of one hydrogen atom ($= 1.67 \times 10^{-24}$ g) is equal to one Dalton (Da). Molecular mass is given in units of Daltons whereas atomic and molecular weights (MW) are unitless.

Units of volume

The SI unit of volume is the cubic metre, m^3 . The litre (l) has been redefined as being equal to the cubic decimetre, although the term litre still remains in common use.

$$1 \text{ litre (l)} = 1 \text{ dm}^3 = 10^{-3} \text{ m}^3$$

$$1 \text{ millilitre (ml)} = 1 \text{ cm}^3 = 10^{-6} \text{ m}^3$$

$$1 \text{ microlitre } (\mu\text{l}) = 1 \text{ mm}^3 = 10^{-9} \text{ m}^3$$

Weight per volume

Concentrations can be given as a % of the weight (w/v) or volume (v/v) of the solute in the final solution. A 1% solution is 1 g or 1 ml of solute dissolved in enough solvent to make a final volume of 100 ml. Some reagents that are

commercially available come supplied as solutions. For example, acrylamide is often supplied as a 30% (w/v) solution (check the minimum assay % on the label). Hydrochloric acid is supplied as a 37% solution. Make sure you take this dilution into account when making up your reagents.

70% (v/v) ethanol = 70 ml ethanol + 30 ml H₂O

10% (w/v) SDS = 10 g SDS + H₂O to a final volume of 100 ml

For viscous reagents such as glycerol, it is more accurate to weigh out the required amount than to attempt to pipette it.

Glycerol CH₂OH.CHOH.CH₂OH = 92.09 MW

Minimum assay = 99.5%

Wt per ml at 20° = 1.257 g

10% (v/v) glycerol = 12.57 g glycerol + 90 ml H₂O

Molarity

Molarity (M) is the concentration of a solution expressed as the number of moles of dissolved substance per dm³ (l) of solution. (Molality is the concentration of a solution expressed as the number of moles of dissolved substance per kilogram of solvent.) A mole is the amount of substance that contains as many entities (atoms, molecules, electrons etc.) as there are atoms in 12 g of ¹²C and is equal to Avogadro's number (6.022 52 x10²³ mol⁻¹). For any chemical compound this will correspond to a mass equal to the relative molecular mass in g.

Molar solutions

Most buffers and reagents will be used in the mM concentration range.

Tris Base [*tris*(hydroxymethyl)aminoethane] = 121.1 MW

Purity > 99%

1 M = 121.1 g Tris + H₂O to a final volume of 1 l

20 mM = 2.42 g Tris + H₂O to a final volume of 1 l

20 mM = 605 mg Tris + H₂O to a final volume of 250 ml

20 mM Tris at pH 7.5 = 605 mg Tris + ~ 200 ml H₂O – adjust pH with 0.5 M HCl and make up to a final volume of 250 ml with water

Hydrochloric acid (fuming) = 36.46 MW

Minimum assay = 35.4%

Sp gr = specific gravity = 1.18 [1 ml = 1.18 g]

1 M = 36.34 g HCl x 2.82 (as 35.4%) + H₂O to a final volume of 1 l

1 M = 102.6 g HCl + H₂O to a final volume of 1 l

1 M = 87 ml HCl (as 1 ml = 1.18 g) + 913 ml H₂O

0.5 M = 10.87 ml HCl + H₂O to a final volume of 250 ml

Remember to always add acid to water.

Buffers and pH

The control of a virtually constant pH is achieved by the action of efficient buffering systems. The major buffering systems found in cellular fluids involve phosphate, bicarbonate and proteins.

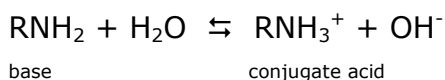
The state of ionisation of a weak electrolyte is dependent upon the prevailing pH and the numerical value of its ionisation constant. For weak acids which ionise according to the equation:



the ionisation constant K_a , is given by the expression

$$K_a = \frac{[\text{RCOO}^-][\text{H}^+]}{[\text{RCOOH}]}$$

In the case of weak bases, which ionise according to the equation:



the ionisation constant may be expressed in terms of a K_b value

$$K_b = \frac{[\text{RNH}_3^+][\text{OH}^-]}{[\text{RNH}_2][\text{H}_2\text{O}]}$$

or more commonly in terms of the K_a value of the conjugate acid

$$K_a = \frac{[\text{RNH}_2][\text{H}^+]}{[\text{RNH}_3^+]}$$

In practice, since K_a values are numerically very small, it is customary to use pK_a values, where $pK_a = -\log_{10}K_a$. For weak bases $pK_a + pK_b = 14$. The precise way in which the state of ionisation of a weak electrolyte varies with pH is given by the Henderson-Hasselbach equation. For a weak acid, this takes the form:

$$pH = pK_a + \log_{10} \frac{[\text{conjugate base}]}{[\text{acid}]}$$

or

$$pH = pK_a + \log_{10} \frac{[\text{ionised form}]}{[\text{unionised form}]}$$

It can be appreciated that weak acids will be predominantly unionised at low pH values and ionised at high pH values. The opposite is the case for weak bases.

Buffer solutions

A buffer solution is one which resists a change in hydrogen ion concentration on the addition of acid or alkali. This resistance is called the buffer action. The magnitude of the buffer action is called the buffer capacity and is measured by the amount of strong base required to alter the pH by one unit. In practice, buffer solutions usually consist of a mixture of a weak acid or base and its salt, e.g. acetic acid and sodium acetate.

In a solution of a weak acid (RCOOH) and its salt (RCOO^-), added hydrogen ions are neutralised by the anions of the salt, which therefore act as a weak base, and conversely, added hydroxyl ions are removed by neutralisation of the acid. It is clear from this that the buffer capacity of a particular acid and its conjugate base will be maximum when their concentrations are equal, i.e. when $pH = pK_a$ of the acid. Buffer capacity also depends upon the total concentration as well as the ratio of acid and salt – the greater the total concentration, the greater the buffer capacity.

The usual concentration of acid and salt in buffer solutions is of the order of 0.05 – 0.2 M and generally the mixtures possess acceptable buffer capacity within the range $pH = pK_a \pm 1$. Physiologically, one of the most important groups of buffers is the proteins. By virtue of their large numbers of weak acidic and basic groups in the amino acid side chains, proteins have a very high buffer capacity. The pK_a

values of some commonly used buffers are shown below. Remember pH is dependent on temperature.

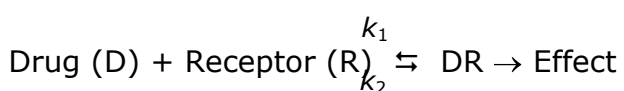
Acid or base	pK _a (at 25°)
Acetic acid	4.75
Carbonic acid	6.10, 10.22
Citric acid	3.10, 4.76, 5.40
HEPES	7.50
Phosphoric acid	1.96, 6.70, 12.30
PIPES	6.80
Succinic acid	4.18, 5.56
Tartaric acid	2.96, 4.16
Tris	8.14

Normality

This is an obsolescent concentration unit (N). It was used mainly for acids or bases and refers to the concentration of titratable H⁺ or OH⁻ in a solution. Thus a solution of sulphuric acid with a concentration of 2 M will be a 4 N solution.

Concentration-effect curves

If one assumes that an agonist or drug interacts reversibly with its target receptor and that the resultant effect is proportional to the number of receptors occupied, the following equation can be written:



The relationship between effect and the concentration of free drug can be described as:

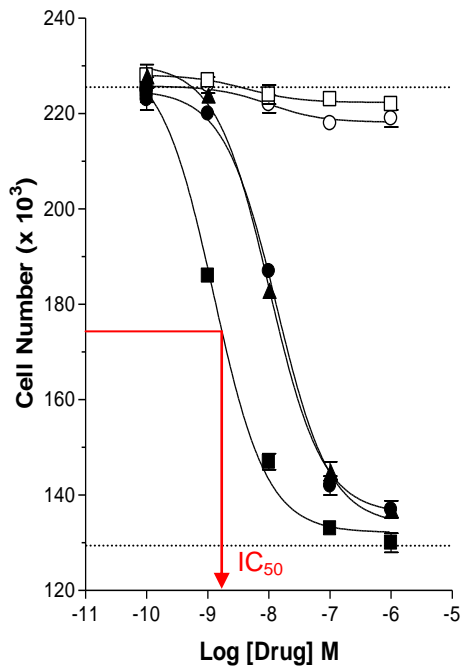
$$\text{Effect} = \frac{\text{Maximal effect [D]}}{K_D + D}$$

where [D] is the concentration of free drug and K_D (equal to K₂/K₁) is the dissociation constant for the drug-receptor complex. The fraction of receptors that

is occupied by the drug is equal to $[D]/(K_D + D)$. This equation describes a rectangular hyperbola and is analogous to the Michaelis-Menton equation that is used to describe the interaction of enzyme and substrate. There is no effect at $[D] = 0$ and the effect is half-maximal when $[D] = K_D$, that is when half of the receptors are occupied. The maximal effect is approached asymptotically as $[D]$ increases above K_D . This scheme defines the drug's potency - that is the dependency of its effect on its concentration. The concentration of the drug at which it is half maximally effective, its EC_{50} value, is equal to its K_D , the equilibrium dissociation constant. K_D has units of concentration and defines the concentration at which the receptor is half-maximally saturated.

It is often convenient to plot the magnitude of effect against $\log[D]$, because a wide range of drug concentrations can be displayed and the potency of different drugs can be compared. In this case, the graph is a sigmoidal log concentration-effect curve. Concentration-effect curves can also be produced for compounds that have inhibitory effects. In this case, the IC_{50} value is often used to denote an inhibitory effect rather than an excitatory effect. The following example shows why it is important to use appropriate concentrations of drugs.

In this example, a submaximal concentration (EC_{80}) of endothelin-1 (100 nM) was used to increase the proliferation of vascular smooth muscle cells in culture. The peptide hormone, somatostatin, caused a concentration-dependent inhibition of endothelin-1-induced proliferation with a pIC_{50} value of 8.8 ± 0.1 ($pIC_{50} = -\log_{10}IC_{50} = 1.5$ nM). Somatostatin analogues were also tested that are selective to individual somatostatin receptor types ($sst_1 - sst_5$). BIM-23027 and L-362,855, agonists for the sst_2 and sst_5 receptors respectively, were approximately 10-fold less potent than somatostatin at inhibiting endothelin-1-induced proliferation with pIC_{50} values of 7.8 ± 0.1 for both analogues. In contrast, the sst_1 and sst_4 receptor-selective ligands, CH275 and NNC-226900, respectively, had no significant effect on endothelin-1-induced proliferation.



The inhibitory effect of somatostatin (■), BIM-23027 (●), L-362,855 (▲), NNC-226900 (□) or CH275 (○) on the proliferative response induced by endothelin-1 (100 nM) in smooth muscle cells. Values are expressed as the mean cell number harvested from a single coverslip against log molar concentration of somatostatin or analogue ($n = 3, 4$ replicates). The vertical lines represent SEM and where no error bar is shown, the SEM lies within the symbol. The dotted lines show no inhibition and maximal inhibitory effects from which the IC_{50} value is calculated = $\log -8.8 \text{ M} = 1.5 \text{ nM}$.

The inhibitory effect of somatostatin was tested against a submaximal concentration of endothelin-1. An optimal window is required where there is enough proliferation to inhibit, but where the concentration of endothelin-1 is below the saturation point for the system. Thus a concentration of endothelin-1 was used which produced 80% of the maximal proliferative response (EC_{80}). To achieve maximal inhibition of this mitogenic response, somatostatin should be used at a concentration that is greater than the calculated IC_{50} . As a rule, inhibitors are often used at a concentration that is 10x this value. The Calbiochem catalogue is a very useful reference for many IC_{50} values. They supply many cell-permeant inhibitors for cell signalling effectors. The above data were analysed using Prism software. The above example should also be considered in terms of physiological effects. Concentrations of somatostatin have been determined in human and animal tissues and are in the low nM range. Thus the concentrations of somatostatin and perhaps more importantly of the stable analogues used in the above example should work in *in vivo* situations.

Isotonic solutions

Physiological solutions must support cell or tissue culture. It is essential that the suspending medium is isotonic with the tissue (i.e. possesses the same osmotic pressure) and is buffered to maintain metabolic integrity.